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Filter device and apparatus for holding the same

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(56) Related Art  
US 4594161  
US 5626761  
US 4231871

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## ABSTRACT

A filter device with an oblong housing having two flow spaces separated from each other by membranes. A bundle of hollow fibers is held in the housing and the fiber cavities constitute the one flow space with the space surrounding the bundle of fibers constitutes the other flow space. At least one connection or connecting piece is provided for each flow space. The connections are disposed on one side of the housing and their center lines extend parallel to each other.

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**AUSTRALIA**  
**PATENTS ACT 1990**  
**COMPLETE SPECIFICATION**

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**INVENTION TITLE:**

**Filter device and apparatus for holding the same**

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

**M103545 06 AUG98**

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This invention relates to a filter device comprising an oblong housing with two flow spaces separated from each other by membranes, and comprising at least one connection or connecting piece for each flow space.

Filter devices of this kind are used for instance as dialyzers, hemofilters or ultrafilters.

Such filter devices preferably used as dialyzers, have been proposed in EP 0,441,721 B1 and EP 0,525,317 A1.

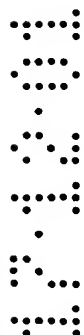
DE-36 41 843 A1 proposes a hemodialysis device including a sterilizing means, where filter devices as mentioned above are used on the one hand as dialyzers and on the other hand as sterile filters for the hemodialysis solution.



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WO88/01895 proposes filter devices whose end caps mounted on their tubular housings are provided with passages extending parallel to each other and communicating with one of the two flow spaces, so that by placing the filter devices close to each other the same can be combined to filter batteries, in which the individual filter devices are connected in parallel. The end caps of the filter devices with the aligned through holes are braced with each other by means of screw bolts, where on the outer sides of the caps sealing plates are mounted, which carry connecting pieces, as far as the respective ends of the through holes should serve as inlets or outlets.



Filter devices as mentioned above usually consist of tubular housings with end caps, which are provided with two axial and two radial connecting pieces for the liquids to be passed therethrough. The connecting pieces are connected with tubes and/or pipe systems by means of usual connections or connectors. These connections not only can frequently be effected by means of complex manipulations, but in addition require expensive connectors with a complicated connection technique, which render the application more expensive. Moreover, the connectors may also be the reason for leakages, which in particular in the hemodialysis can lead to serious damages to health.

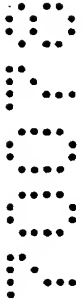
The invention provides a filter device comprising a central housing which is closed at opposing ends by two end caps;



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two flow spaces in the housing separated from each other by membranes;

at least one connection or connecting piece for each said  
5 flow space,



wherein the connections or connecting pieces are disposed  
on one side of the housing and their center lines extend  
parallel to each other, and

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wherein the connections or connecting pieces are located in  
said end caps whereby said at least one of said connections  
or connecting pieces is provided in each said end cap.



15 The filter device in accordance with the invention can be  
connected quickly and easily with a filter or dialysis  
machine or a housing holding the filter device by plugging  
it in such that the connections or connecting pieces come  
into sealing engagement with mating connections or  
20 connecting pieces. The connections or connecting pieces  
and the counterparts thereof may be adjusted to each other  
such that they can sealingly be connected with each other  
by plugging them in or also by pushing them together.

25 Preferably the device includes a bundle of hollow fibers  
held in the housing, the fiber cavities constituting the  
one flow space and the space surrounding the bundle of  
fibers constituting the other flow space.

30 It is preferred that two connections or connecting pieces  
are provided in each said end cap.



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The connections or connecting pieces may have tubular orifices.

The orifices of the connections or connecting pieces may be disposed in mutually parallel planes or also in a common plane.

The centre lines of the orifices expediently lie on a common longitudinal plane, which may include the centre line of the housing or extend parallel to the centre line of the housing.

The orifices may also lie on mutually parallel planes, which extend radial to the housing.

In accordance with a preferred embodiment the housing itself, which expediently consists of a tube section, is free from connections, so that the housing wall may be designed thinner and thus in a material-saving way. When the connections or connecting pieces are provided at the end caps, the same may be designed more rugged without applying a load onto the housing itself.

In accordance with a preferred embodiment it is provided that the end caps are provided with radial beads extending over the end surfaces thereof, where the connections or connecting pieces open into the ends of said beads, said ends protruding over the cap edges. In this way, a particularly stable construction is ensured, which keeps the housing portion enclosed between the caps free from connections and stresses resulting therefrom.



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connections and stresses resulting therefrom.

An apparatus may be provided for holding the filter device of the preferred embodiment.

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It is therefore the object of a preferred embodiment of the invention to create a filter device as described above, which provides for a simple and safe connection to a tube or pipe system.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the drawings, wherein:

Fig. 1 shows a view of that side of a filter device according to a preferred embodiment of the invention into which open the connections thereof,

Fig. 2 shows a section through the filter device along line A-A of Fig. 1,

Fig. 3 shows a side view of the filter device in accordance with Fig. 1, rotated by 90°,



Fig. 4 shows a top view of the filter device in accordance with Figs. 1 to 3,

Fig. 5 shows a perspective view of the housing of the filter device with lifted end caps,

Fig. 6 shows a perspective view of the filter device in accordance with Figs. 1 to 5, which has been inserted in a holding member of a filter or dialysis machine,

Fig. 7 shows a perspective view of the holding member in accordance with Fig. 6, without the filter device held in the same,

Fig. 8 shows a rear view of the holding member in accordance with Figs. 6 and 7,

Fig. 9 shows a section through the holding member along line A-A of Fig. 8,

Fig. 10 shows a section through the holding member along line B-B of Fig. 8,

Fig. 11 shows a section through the holding member along line C-C of Fig. 8,

Fig. 12 shows a section through the holding member along line D-D of Fig. 8,

Fig. 13 shows the carriage of the holding member, which carries the lower spouts, in an exploded view of its individual components.

The filter device according to a preferred embodiment of the invention consists of a tubular housing 1, whose ends have enlarged diameters due to bell-shaped edge portions 2.



At the inside of the bell-shaped edge 2, freely protruding strip-like projections 3 are connected, which have approximately the same distance from each other over the periphery and are aligned with the cylindrical wall of the housing 1. These strip-like projections serve to hold the sealing compounds bonding the ends of the bundle of fibers not represented here.

The end faces of the cylindrical edges 4 of the approximately cup-shaped end caps 5 are bluntly abutting against the ring-shaped end faces of the bell-shaped edges of the housing 1. The end faces of the end caps 4 and the edges 2 of the housing 1 are sealingly bonded or welded together.

On the convex bottom surfaces 6 of the end caps 5, radially extending nose-shaped beads 7 have been mounted, which protrude beyond the caps 5 towards one side. Into the ends of the beads 7 radially protruding beyond the end caps 5 are two pairs of connections or connecting pieces 8, 9 and 10; 11 respectively. Each connecting piece 8, 9, 10, 11 have orifices which lie in a common plane parallel to the centre line of the housing 1. The outwardly disposed connections or connecting pieces 8, 11 communicate with the fiber cavities not represented here, whereas the inner connections or connecting pieces 9, 10 open into the space of the housing enclosing the bundle of fibers.

The orifices of the connections 8 to 11 are enclosed by the end face of the beads 12, 13 in a frame-like manner, which beads are provided on their outside with outwardly protruding, mutually parallel ribs 14, 15, which serve to anchor the connections on a holding member of the housing, which is provided with mating connections for the connections 8 to 11, where connecting the connections can be effected by simply plugging or pushing them in.

The housing 1 and the caps 5 usually consist of injection-molded plastic parts.



Fig. 6 illustrates a holding member designated as a whole by the reference numeral 21, which in a manner not represented here is attached to the housing of a filter or dialysis machine. Into the holding member 21, the filter device as described in Figs. 1 to 5, which has been designated as a whole by the reference numeral 20, has been inserted such that its connections 8 to 9 are tightly connected with extensible spouts of the holding member 21.

The holding member 21 consists of a concave housing 22, whose open side is connected with the housing of a filter or dialysis device such that its peripheral edge rests against the outside of a housing wall.

The concave housing comprises a central recess 23, so that upper and lower housing portions 24, 25 protrude and enclose the recessed central housing portion 23.

In the protruding upper and lower housing portions 24, 25 aligned grooves 26, 27 are provided, which are freely flared to the top in a funnel-shaped way. In their opposing flanks the aligned grooves 26, 27 are provided with further grooves 28, 29, which towards the outside are defined by shoulders 30, 31. The upper shoulders 30, 31 are provided with step-like stops 32.

The width of the nose-shaped beads 7 of the filter devices 20 directly before the ribs 14, 15 forming the outer edges corresponds to the distance between the shoulders 30, 31 of the grooves 26, 27, so that the filter device can be inserted from the top via the funnel-shaped inlets into the grooves 26, 27 of the holding member such that the ribs are guided in the grooves 28, 29 provided in the flanks and engage behind the shoulders 30, 31 of the grooves 26, 27. The frame-like end faces of the beads 12, 13 can be pushed into the grooves



26, 27 of the holding member 21 until the lower edge 33 of the frame-like border of the end face of the upper bead 12 abuts against the stops 32 formed in the shoulders 30, 31. In this position, the two upper spouts 34, 35 are aligned with respect to the upper connections 8, 9, so that these spouts can be engaged in the connections.

The lower spouts 36, 37 are engaged in the lower connections 10, 11 upon corresponding alignment.

The upper spouts 34, 35 are disposed on a sliding block 40, which is guided on five pins 41 to 45 so as to be longitudinally movable. The pins 41 to 45 have been screwed into holes in the housing. The pins 41 to 44 are provided with enlarged heads on which the one ends of compression springs are supported, whose other ends abut against the sliding block 40 and act on the same in the direction of the housing wall 46. In the side walls of the housing 21 a shaft 47 is rotatably supported, which carries an external lever 48. On the shaft 47 in the housing an eccentric 49 is mounted, whose eccentric surface can roll on the adjacent wall of the sliding block 40 as shown in Fig. 9. By means of the lever 48 the eccentric 49 can be rotated into its dead center position or beyond its dead center position, in which the sliding block is moved to the inside on the pins 41 to 45, so that the springs are biased even more. In this biased form, the filter device 20 is inserted into the grooves 26, 27. When the lever 48 is now swivelled inwards from its upright position, the eccentric 49 will snap into its position shown in Fig. 9, so that the compression springs move the sliding block 40 to the outside and sealingly connect the spouts 34, 35 with the connections or connecting pieces 8, 9, so that the spouts 34, 35 are connected with the connecting pieces 8, 9.

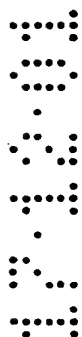
The pin 45, which is not enclosed by a compression spring, serves to guide the sliding block 40 in the housing 21.



The spouts 36, 37 are disposed on a sliding block 50, which is guided on the pins 51 to 55, whose front ends have been screwed into the block 56, where the pins 51 to 54 enclose compression springs, which are supported on the one hand on the enlarged heads of the pins and on the other hand on the sliding block 50. The further pin 55 exclusively serves to guide the sliding block 50.



In the side walls of the block 56 a shaft 58 is supported, on which two eccentrics 59, 60 are mounted, which in the manner shown in Fig. 11 can be supported on covering walls 61, 62 of the sliding block 50, which define lateral recesses of the sliding block 50. The spouts 36, 37 connected with the sliding block 50 extend through holes 63, 64 in the block 56.



The sliding block 50 is provided with a centering pin 65 in line with the spouts, which extends through the block 56 in a further hole 66. The centering pin 65 is provided with an inclined face as shown in Fig. 7.

The spouts 36 and 37 as well as the centering pin 65 extend through the bottom of the groove 27 in an oblong hole 68 shown in Fig. 7, in which the same are movable to a limited extent.

As shown in Figs. 11 and 12, the block 56 is provided with lateral skids 69, 70, so that it is movable to a limited extent in complementary guiding grooves in longitudinal direction of the housing 21.

On the outside of the housing 22, the shaft 58 carrying the eccentric 59, 60 is provided with a lever 72, by means of which the eccentric shaft can be rotated.



Prior to inserting the filter module 20 into the grooves 26, 27 of the housing 21, the two levers 48 and 72 are brought into the vertical position, so that the eccentrics will bias the sliding blocks 40 and 50 as described above, and the spouts are in their engaged position. Subsequently, the filter module 20 is inserted into the grooves, until the lower edge 33 of the frame-like end face of the bead 12 is supported on the stops 32. For connecting the spouts 34, 35 with the connections 8, 9, the lever 48 is then shifted as shown in Fig. 7, so that the spouts 34, 35 come into a snapping and sealing engagement with the connections 8, 9.

Subsequently, the lower lever 72 is also shifted, so that the lower sliding block is extended and the spouts 36, 37 come into snapping engagement with the connections 10, 11 of the filter module. If due to manufacturing tolerances the distance of the spouts from the connections 10, 11 is not absolutely correct, the same will be aligned by the adjusting pin 65, whose inclined surface acts upon the upper edge of the frame-like border of the end face of the lower bead 13 of the filter module and by means of its inclined surface 67 lifts the carriage-like block 56 to such an extent that the aligned spouts 36, 37 can move into the recesses 10, 11.

For attachment in a housing wall of the filter or dialysis machine the concave housing 21 is provided with feet on the rear side, which have locking recesses for connection.

The concave housing 21 and the sliding blocks as well as the carriage-like block 56 may consist of injection molded plastic parts.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.



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The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that prior art forms part of the common general knowledge in Australia.

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## THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A filter device comprising a central housing which is closed at opposing ends by two end caps;

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two flow spaces in the housing separated from each other by membranes;

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at least one connection or connecting piece for each said flow space,

wherein the connections or connecting pieces are disposed on one side of the housing and their center lines extend parallel to each other, and

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wherein the connections or connecting pieces are located in said end caps whereby said at least one of said connections or connecting pieces is provided in each said end cap.

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2. The filter device as claimed in claim 1, wherein the connections or connecting pieces have tubular orifices.

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3. The filter device as claimed in claim 1 or 2, wherein the orifices of the connections or connecting pieces lie in mutually parallel planes.

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4. The filter device as claimed in any of claims 1 to 3, wherein the orifices of the connections or connecting pieces lie in a common plane.



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5. The filter device as claimed in any of claims 1 to 4, wherein the center lines of the connections or connecting pieces lie on a common longitudinal plane.
- 5 6. The filter device as claimed in any of claims 1 to 5, wherein the center lines of the orifices lie on mutually parallel planes.
- 10 7. The filter device as claimed in any of claims 1 to 6, wherein the connections or connecting pieces are provided at the end caps of the housing.
- 15 8. The filter device as claimed in any of claims 1 to 7, wherein the end caps are provided with radial beads extending over the end surfaces thereof, the connections or connecting pieces open into the ends of said beads, said ends protruding beyond the cap edges.
- 20 9. The filter device as claimed in any of claims 1 to 8, wherein two connections or connecting pieces are provided in each said end cap.
- 25 10. The filter device as claimed in any of claims 1 to 9, wherein a bundle of hollow fibers is held in the housing, the fiber cavities constituting one flow space and the space surrounding the bundle of fibers constituting the other flow space.



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11. A filter device substantially as hereinbefore described  
with reference to Figures 1 to 6.

5 DATED this 14th day of December, 2001

**Fresenius Medical Care Deutschland GmbH**

By DAVIES COLLISON CAVE

10 Patent Attorneys for the Applicant



FIG. 1

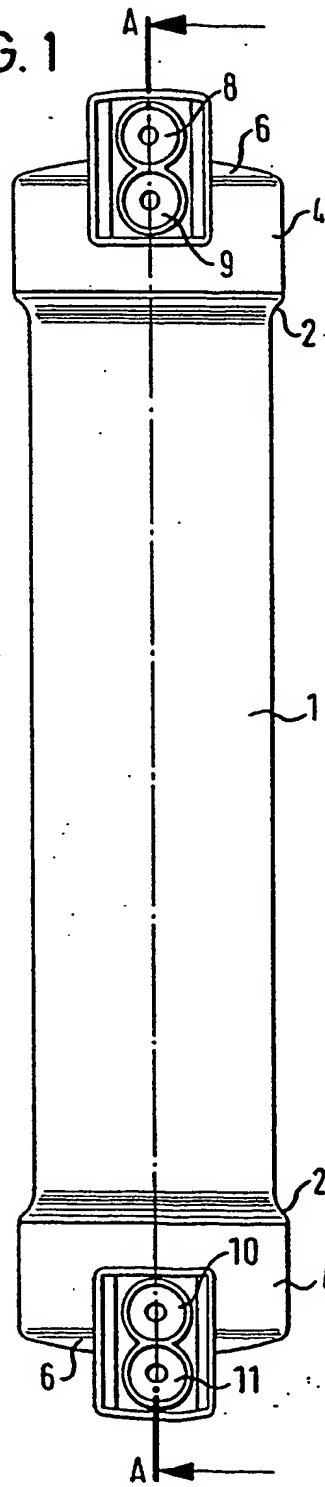


FIG. 2

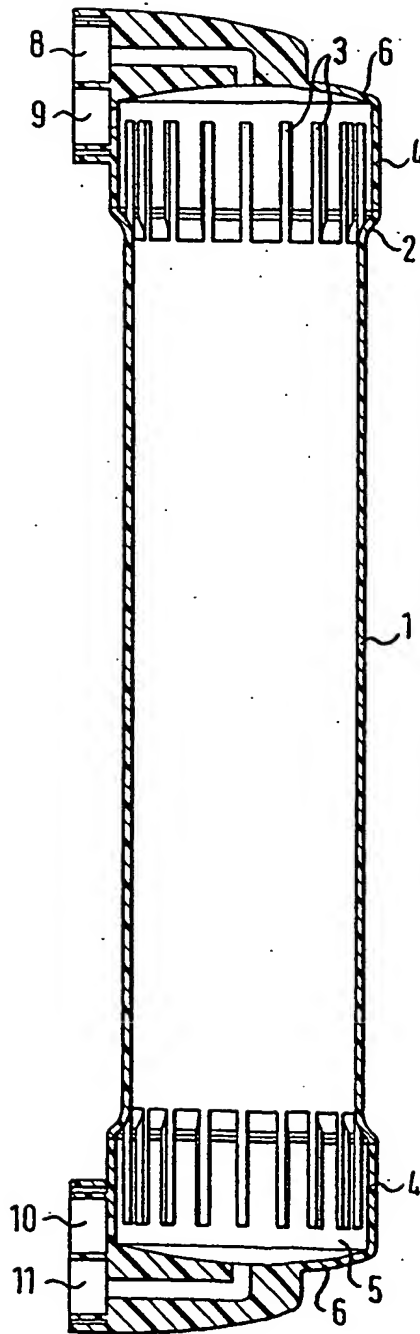


FIG. 3

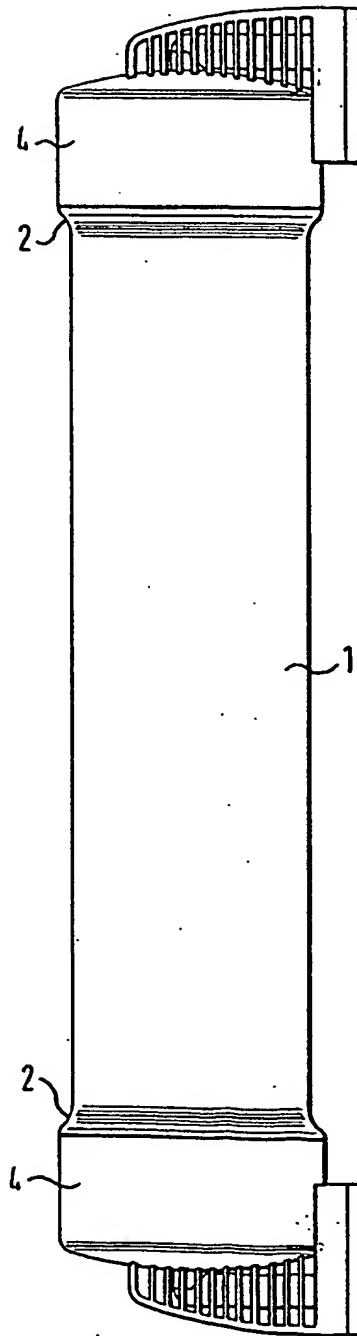


FIG. 4

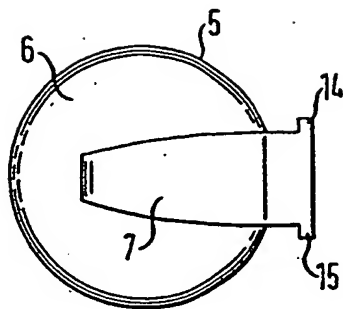


FIG. 5

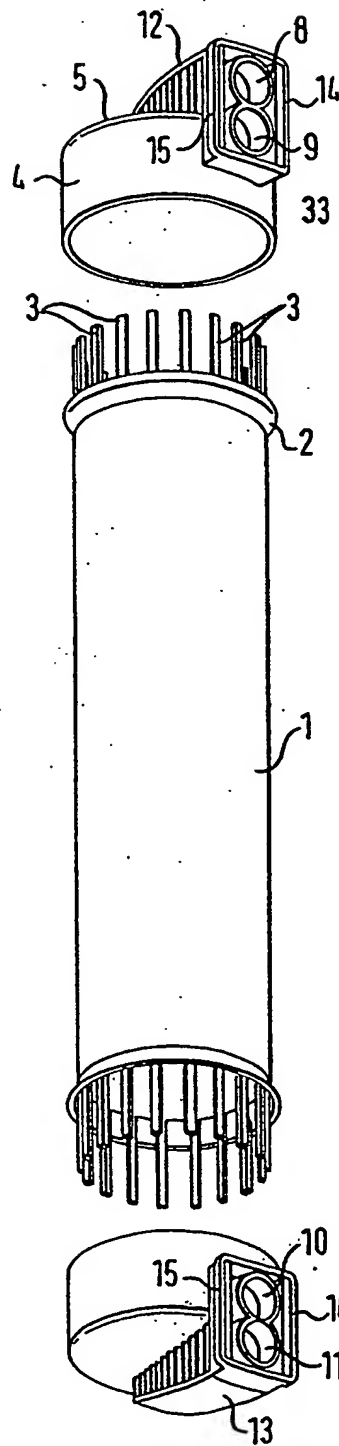




FIG. 6

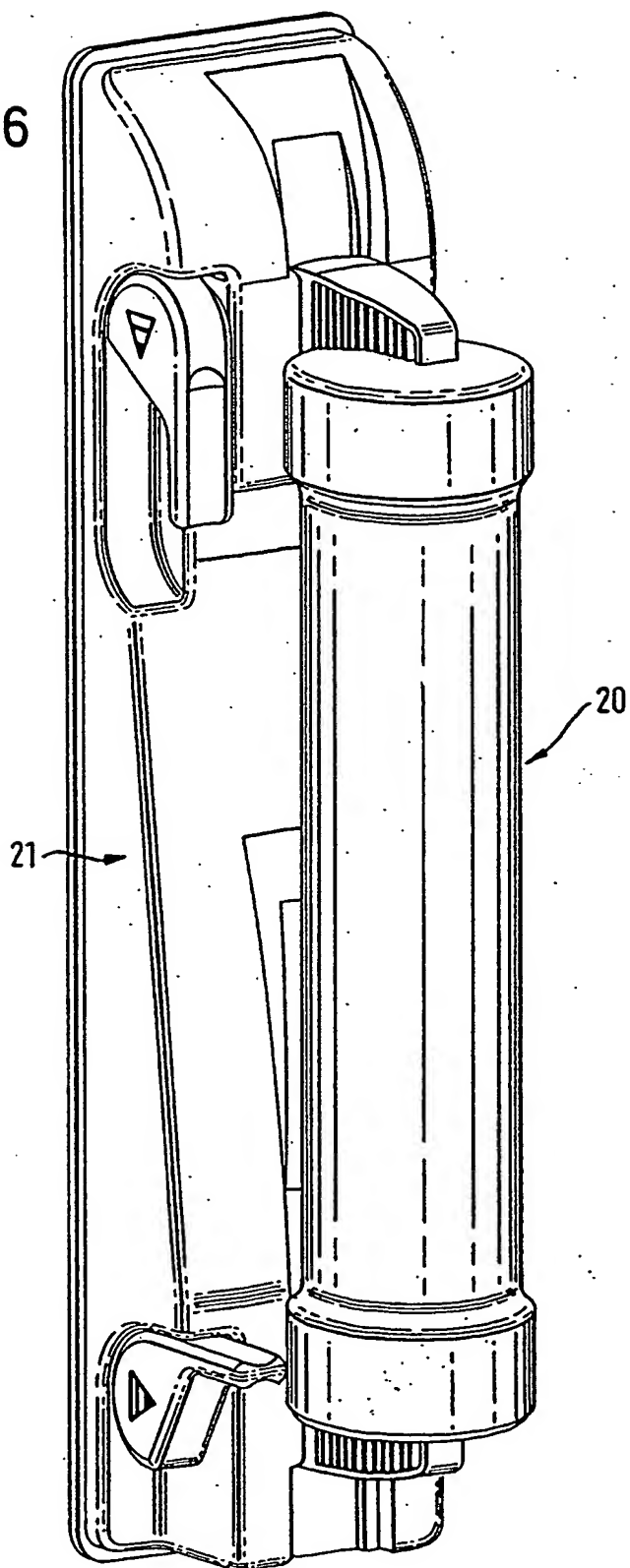


FIG. 7

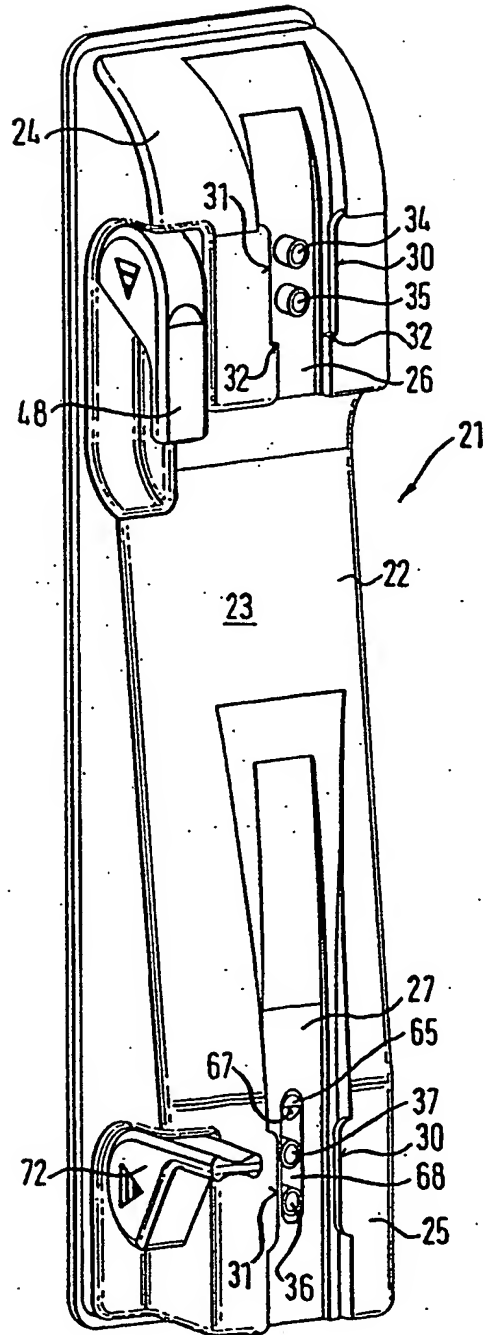


FIG. 10

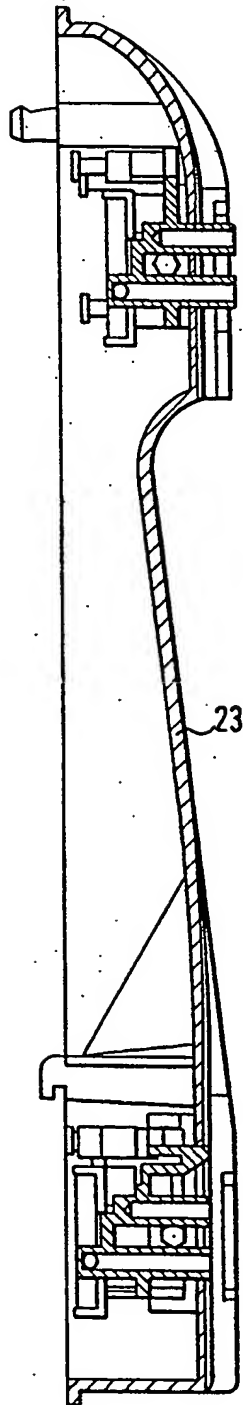


FIG. 8

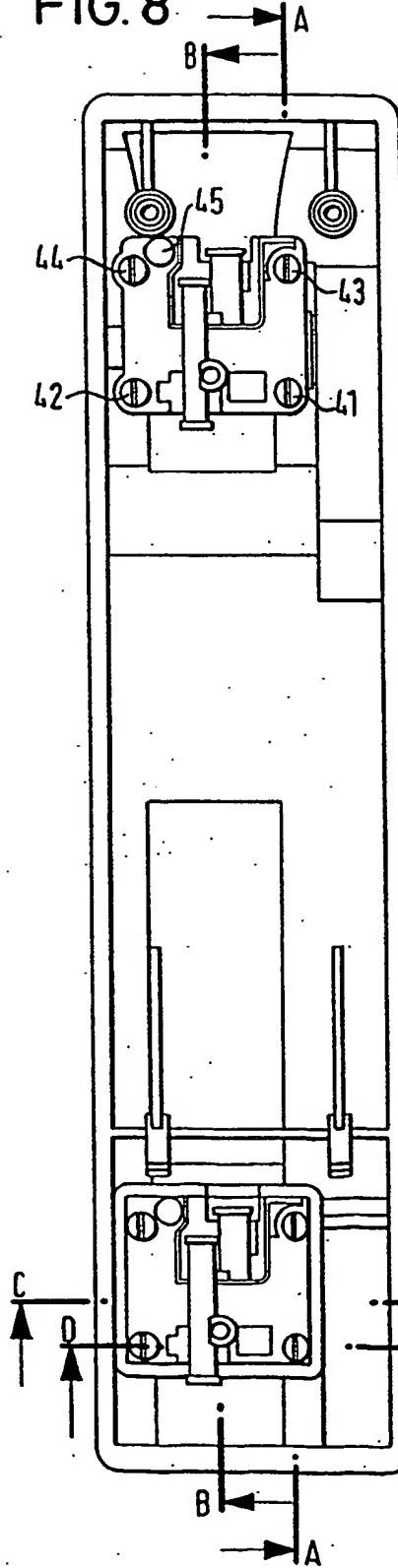


FIG. 9

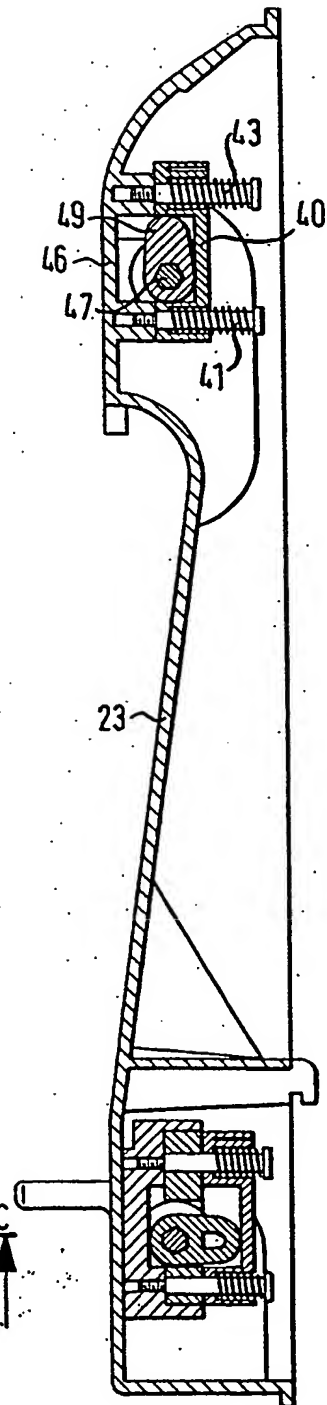


FIG. 11

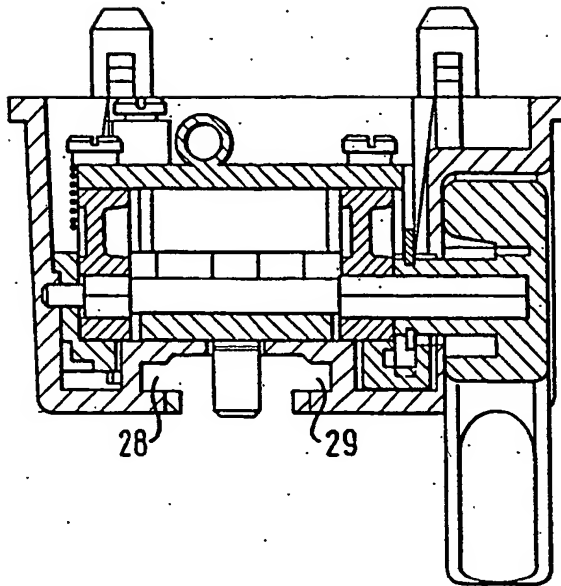


FIG. 12

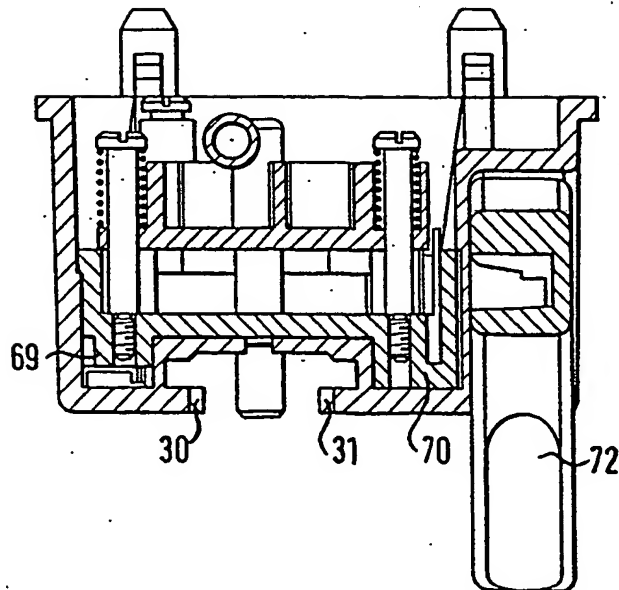
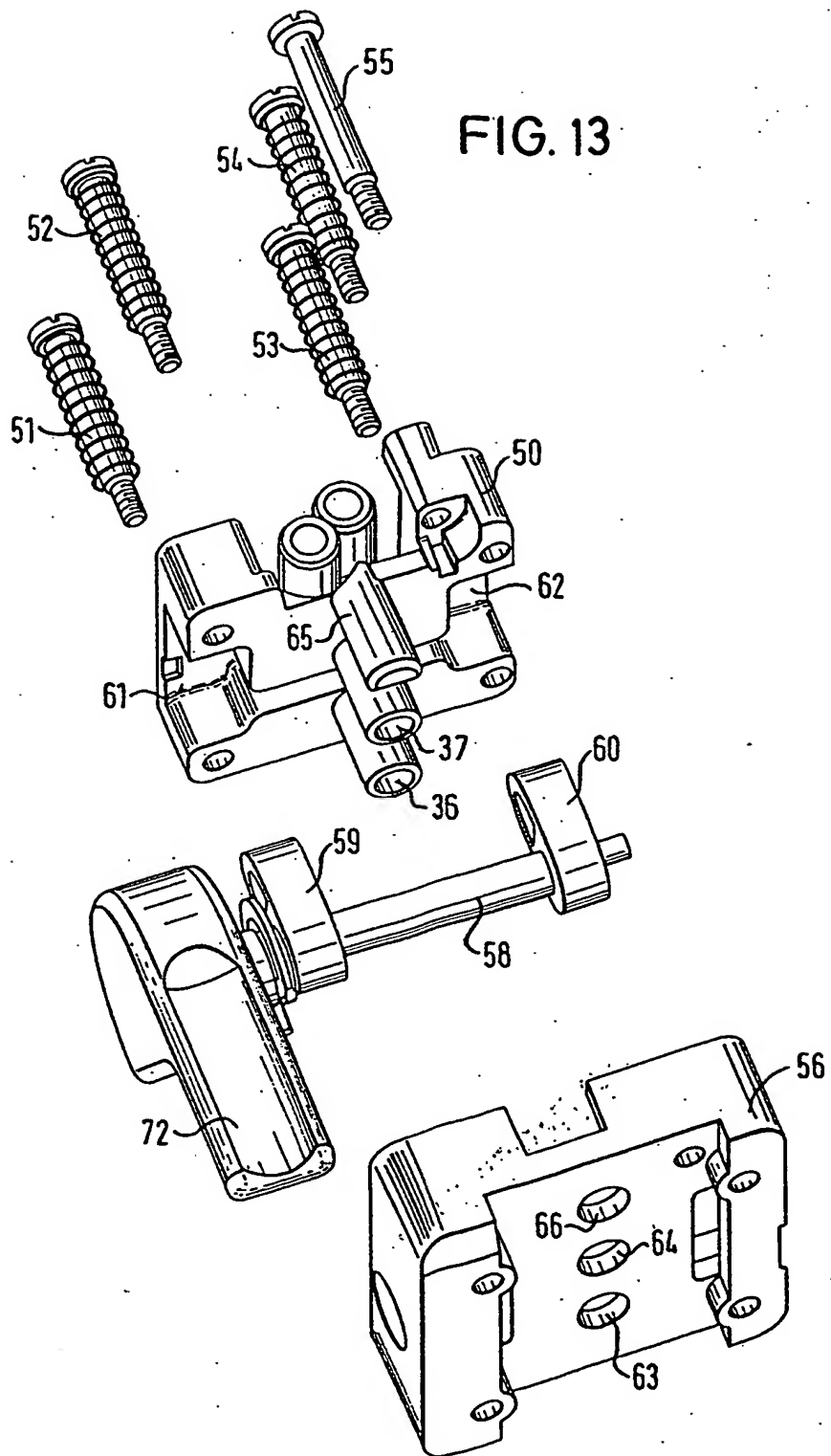


FIG. 13



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